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# AVIATION AND AERONAUTICAL ENGINEERING



(c) Paul Thompson

Naval Airship C-5 Passing Over Naval Seaplane NC-4

VOLUME VI  
Number 8

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MAY 15, 1919

**AVIATION**  
AND  
**AERONAUTICAL ENGINEERING**

VOL. VI. NO. 8

*Member of the Audit Bureau of Circulations*

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## AVIATION AND AERONAUTICAL ENGINEERING

ALEXANDER KLEMIN  
TECHNICAL EDITOR  
LADISLAV HORST  
ASSOCIATE EDITOR  
FRANCIS NEWBOLD  
EDITORIAL MANAGER

Vol. VI

May 15, 1935

No. 3

The successful completion, by two of the three instances, of the NC seaplane Division 1, under the command of Captain John H. Towers, U. S. N., of the 1000-mile cruise from Boston, naval air station to Trepassey, N. F., augurs well for the outcome of the transatlantic flight attempt of the United States Navy.

Despite atmospheric conditions which were on the whole decidedly unfavorable to such a long-distance flight and must have put the mechanical as well as human element to a considerable strain, the two NC seaplanes accomplished the initial part of their great journey without any serious delay and reached their appointed starting place in fully serviceable condition. This cruise furnishes increasing evidence of the fact that the multi-engine flying boats upon which the Navy bases its faith for being the first to cross the Atlantic by its aerial route are, notwithstanding the comparative novelty of their design, by no means experimental machines, but are, on the contrary, fully qualified to undergo that crucial test of efficiency represented by the oceanic flight.

In events particularly fitting that this country should be represented in the transatlantic flight competition by seaplanes of the boat type, which are a typically American development—even more so perhaps than the airplane. Indeed, the latter, after having been invented in this country, was mainly perfected in Europe, whereas the seaplane owes virtually its entire progression from the feeble attempts at making an airplane float on a canoe-like structure to the 14-ton flying boats which are to carry the Ruses and Skopes across the Atlantic to American inventive faculty and scientific achievement and more particularly to one man among so many other contributors to the art of marine flying—Glen H. Curtiss.

It was Curtiss who, some eight years ago, built the first boat type seaplane that proved its practicability by repeatedly duffing from and alighting on the surface of the sea at San Diego. It was he again who, realizing the drawbacks of this type for sea service, created the following year the boat type seaplane or flying boat which by the substitution of a boat like hull means greater maneuverability than the "floating airplane"—a seaplane's conception. Finally, when it became evident that the difficulties of open sea could be overcome only by a considerable increase in size, it was again Curtiss who did pioneer work in developing the first true, engine flying boat, the Amerigo, which was successfully delivered to cross the Atlantic.

The Amerigo opened a new era in the history of marine flying, for this craft was the forerunner of the large

multi-engine flying boats which have so well proven their worth in the Great War, and may also be considered as the ancestor of the NC seaplanes, in whose initials the names of the Navy and of Curtiss are united.

Therefore such triumph as all Americans fervently hope will befall the NC seaplanes on their journey across the Atlantic may truly be called an All American victory.

### Ground School and Flying Instruction

A recent enquiry from a prospective flying student referred to a school where both ground school work and flying work would be included. No such school seemed to be available. Prior to the war the very term ground school work was unknown and a flying school meant purely and simply a school where flying was taught.

The old text theory was that, on the whole, the less a pilot knew of aerodynamics and theory the better, and that he ought to know as much about his machine than he could learn in a several chapters. This may possibly apply to the pilot who takes up flying as a pleasant sport, but such a training will not suffice at all for the professional pilot who wishes to make flying his life's work. The more ground school training such a man absorbs the better equipped he will be as a professional pilot.

From the engine standpoint, he will handle his machine much better in the air if he understands when the engine really is, if he can make intelligent observations of its behavior in the air itself, if as the interesting and complicated mechanism that it is, he is able to judge how well the mechanics have tuned it for him, and in case of need, due to a forced landing in cross-country work he is able to make such minor repairs as may save valuable time and enable him to continue his journey.

It is the man who goes up in the plane who is most interested in knowing that the plane is rigged just right, that all the controls are properly adjusted, that the machine is well balanced. A knowledge of Rigging and Principles of Flight will make a much better sense on the same and serve as a check on designers.

With the increasing length of cross-country flying the pilot must be able to understand aviation and the wire how direction finds, and have a fair acquaintance with the principles of navigation. Later on he will probably even have to possess a working knowledge of Federal or State regulations.

The increasing complexity of his job will be a decided benefit to the pilot and raise his status from that of an aerial chauffeur to that of an air navigator working with the captain and mates of seaplane vessels.







## The Lepère Two-Seater Fighter

One of the most successful planes developed during the war in the Lepère two-seater fighter, designed and built by Capt. Georges Lepère, with a group of French associate engineers, at the plant of the Farman Motor Car Co., Detroit.

It belongs in the class of two-seater fighters of the D.H. 5 and Bristol types, and would seem to mark progress over both these makes.

**Flying Qualities**—The machine exhibits excellent flying qual-



FIG. 1. REAR VIEW OF THE LEPÈRE TWO-SEATER FIGHTER

ties, with ready response of all controls. Longitudinal, lateral and directional stability of the machine is good. In taking-off, starting and landing it is entirely satisfactory, and on landing it does not roll more than 300 or 400 ft. All stall maneuvers can be readily performed, and in general, from a pilot's point of view, the machine is excellent.

The range of vision is very good, the controls well placed,

it is worth while to achieve this at the expense of no load greater head resistance in a doubtful point.

Another striking peculiarity of this design is the fact that there are no pylons or stay wires in the plane, these being replaced by a system of parallel framed struts as shown in Figs. 3 and 5. These are built up of layers of spruce. Muscular action of alone is sufficient wires during wind test would seem to indicate that the actual stresses in them is rather reduced.

Such stresses by light loads, and portal frames of the elevator are also strong. They have the disadvantages of extra weight, but not down resistance and have the advantage of simplicity.

The fuselage wing struts are of a type similar to the other struts, but go right down through the fuselage and rest on the heavy beams which connect through the span of the lower



FIG. 2. SIDE VIEW OF THE LEPÈRE TWO-SEATER FIGHTER

and instruments so arranged that the pilot need only move his eyes.

**Wing Frame**—The wing frame offers a number of interesting peculiarities. In addition to the usual 30 and landing wires, two wires are carried forward to the chance struts, where these support the fuselage from the upper and rear spars at the inner strut points, these wires being partly on left wires and partly on external drift wires. From the lower strut points wires are carried to the chance, where a stout strap is carried across. This bracing is very strong, because left was referred to the chance certainly carry some of the left load, but neither

wire. These struts may be seen in Fig. 4.

The main spar is of the usual spruce nailed I-section type, and the leading edges are aluminum strips 1 1/2 x 1/2 in., to which the ribs are riveted.

The ribs are strongly reinforced by tubular fitting spruce stiffeners glued to the web of the main spar. A piece of doped tape wrapped around the rib at each stiffener holds the doped tape in close contact with the web of the stiffener. Three-ply heavy doped cover the upper surface of each wing from the front spar to the leading edge, adding stiffness in the plane of the drift frames and taking up slat stresses and high aerodynamic effects on the wing.

The fittings throughout are rather heavy, but have some desirable features. Fig. 4 is a sketch of one of the spar fittings taking 30, drift and landing wire members. The main part of the fitting is built up of two pieces of 1/4 in. gaps riveted and overlaid together and fastened to the spar by two 1/2 in. bolts passing horizontally through the spar at the outer end. The flap for the lateral drift wire is held on by the main two bolts. The framed complete struts are held rigidly at each corner to the spar by four 1/2 in. bolts passing through plates on the upper surface of the wing, as shown in Fig. 4.

The weight per square foot of the main frame is 14 lb., which is somewhat heavier than the average for a plane of this type. But the factor of safety on wind test was very high, attaining a value of 8.5.

**Adverse Control**—The adverse control is of the rigid type, very much liked by French constructors and resembling it

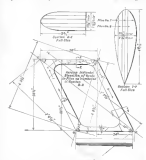


FIG. 3. DETAIL OF THE WING STRUCTURE

found in England and this country. A somewhat heavy push rod is carried through the wings and with a simple bell crank lever mechanism is made to the adverse arm (Fig. 5) on the lower adverse. Another adverse arm is placed on the upper surface of the adverse and connects to the upper adverse in a small steel strut inserted into a part of the adverse arm. The control is very rigid and positive.

**Tail Surface**—The general arrangement of the tail surfaces may be gathered from Figs. 1 and 2. The stabilizer is supported by two steel rods on either side and fits snugly on the inner scraped fuselage. The elevator is of very simple construction. The ribs are all spruce, with no aluminum in the web. The main spar is built up of spruce and 3-ply mahogany, while the secondary spar is a spruce rod. A 1/2 in. strip of aluminum forms the trailing edge, with a half inch to shape for the correct portion of the tip. The main spar is in two parts, welded together and held to the main spar by four bolts, a very simple and efficient attachment. The stabilizer and rudder are of very similar construction, the ribs are no spar, but are covered with thin 3-ply.

The actual controls call for no special notice. In wind testing, the horizontal control failed at 20 lb. sq. ft., and the rudder main spar yielded at 20 lb. sq. ft. With slight subsequent adjustments, both systems were ultimately satisfactory.

**The Fuselage**—The fuselage is of exceedingly strong but somewhat heavy construction. It is covered by side panels

of 6-ply veneer, running from end to end, of a total thickness of 5/32 in., and composed of 3-ply 1/32 in. mahogany, 3-ply 1/32 in. mahogany and 1-ply 1/32 in. white wood. At the engine end of the fuselage, the side veneer panels are not joined so as to follow the longitudinal system, and the cut-outs provide glands of resistance for engine and radiator. The lower panel

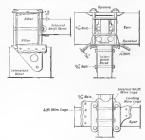


FIG. 4. FITTINGS AT MOTOR, UPPER, FRONT, INTERMEDIATE AND LOWER RIBS

is of 3-ply, 3/32 in. total thickness, built up of 3-ply 1/32 in. mahogany and 1-ply 1/32 in. white wood. As well as being attached to the longitudinal, the side and bottom panels are laced together. Transverse panels are placed at intervals along the fuselage, and in all, including a small bulkhead at the center of the engine bed. A system of diagonal bracing is also carried

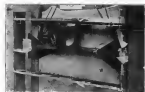


FIG. 5. ADVERSE CONTROL

along the fuselage, the diagonal bracing consisting of paired spruce struts solidly glued and latching into the longitudinal.

**Engine Mounting**—At the front fuselage wing struts, the upper lagging is cut away to allow space for the engine struts. Two short spruce lugs are attached to the front end of the engine mounting. This introduces an element of weakness, compensated, however, by a wire brace carried from the front end of the engine bracket to the top of the fuselage wing struts. The engine bracket uses of spruce with a top of all spruce



# Course in Aerodynamics and Airplane Design

## Part III.—Experimental Aeronautical Engineering

By Alexander Klemin

*Technical Editor, Aviation and Aeronautical Engineering; Consulting Engineer, Aerial Mail Service; Consulting Aeronautical Engineer*

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### Section 4. Chassis Testing

Chassis testing is a many-requirement as a most satisfactory basis. The magnitude of the forces coming into play depends entirely on the type of landing made. If the pilot flutters out, then at a distance of a foot or so above the ground, sharpens his speed before coming down, and makes a gentle three-point landing, he may impose on the chassis a

between front and rear struts which represents a landing with propeller axis horizontal in purely conventional, and, although providing a simple method of comparison, will by no means be fair to every type of landing gear. This type of landing is called a fair comparison, since it will, in a safe, simple form between front and rear struts.

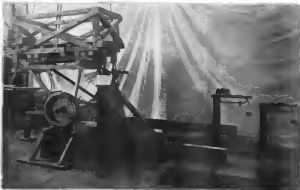


FIG. 1. GENERAL ARRANGEMENT FOR CHASSIS TESTING

dynamic loading not exceeding 1½ times the weight of the machine. If he lands head-on, straight from the glide, he may impose the most severe shock, which the chassis can barely stand.

There is also the difficulty that whereas a three-point landing for a typical chassis such as the D.H. 5 (discussed later in this section) will show the greater part of the load on the forward strut, a landing with the propeller axis horizontal will divide the load more evenly between the front and rear struts, while a landing head-on, or the meeting of a loop while landing on the ground, will throw the load mainly on the rear strut.

Before the generally accepted chassis strength factor of 5 or 7, and the testing of chassis to reproduce this factor of load

There also arises the question of sideways or side-loading. In this the chassis has to stand a large transverse component. To test a chassis under conditions simulating this, it is more easy to load on a laterally inclined platform, with a support placed against the wheel on the lower portion of the incline. This inclination, in the few cases of test before conducted, has been such as to give a transverse load of one-third the vertical load, but the method is by no means fully developed.

**Previous Methods of Testing Chassis.** In Fig. 1 is shown a typical set-up of a chassis for test. A strong, well-braced rig is fixed to the wall of the building in which the test is being conducted. It carries at its end a loop-like structure in which the pay load can be piled. The chassis is set up underneath it

such factors that it corresponds to the propeller-horizontal attitude of the machine. Enough padding is used to show in the photograph, to get the correct position for the chassis. The wheels are placed on heavy beams, whose only rest on axle bases, so that the tendency for unequal loads to creep on



FIG. 2. POINTS AT WHICH DEFLECTIONS ARE MEASURED ON CHASSIS

the two wheels may be eliminated. Axles are placed at the front end of the pay, to support it, while load is being piled on. In measuring deflections a long lever-like arrangement has to be employed, so that it is not necessary for the observer to



FIG. 3. LOADING METHOD OF TESTING CHASSIS

go underneath the chassis. The points at which deflections are measured are shown in Fig. 2. Measurements of all these points are necessary, and in its other way, the net movement of the axle relative to the struts, and the true deflection of the center of the axle relative to the axle, be obtained. Loads are generally applied on increments of about 500 lb. In Table I are given the deflections measured for an N.E.5 chassis

(turned chassis 5 later in this section), which is that of a single motor craft having a gross load 2550 lb., and also in Table II the net deflections of the axle with respect to struts, and deflection of axle center relative to axle.

In English practice it is customary to adopt a different



FIG. 4. POSITION OF CHASSIS A

method of testing. The chassis is connected to a platform, as shown in Fig. 5, which is hinged at one end and is loaded with shot bags. It is allowed to drop from a definite height a num-



FIG. 5. CHASSIS B BEFORE TEST

ber of times, the force of the blow being increased in each test. This method has the advantage of measuring more closely the conditions of a blow, but provides only deflection measurements, and also does not permit the exact fitting load to be found so accurately.

**Results of Tests.** In Table III are given results of tests for chassis of some typical machines.





The total weight of this body was 185 lb. or, apportioned as follows:

Longeron	27 1/2
Spacer beams	17 1/2
Walls, including motor	10 1/2
Backbone	40 1/2
Engine	10 1/2
Painting	10 1/2
Wires	10 1/2
Sheet	100 1/2

This body failed under a dynamic loading of 4 kg. giving way over the point of support located at the attachment for the rear lift wire (Fig. 3). This failure was due to the fact



FIG. 3. WIENNA ENGINE TEST PROBLEM

that the very large reactions at the point of failure did not coincide with the line of vertical support at the longeron, which results in a reactive action about the point of support and the consequent pulling away of the backbone. It is considered advisable to omit lightning bolts in a backbone of this type.

**Wienner DSC-2 Type**—This control body was similar in outline and general construction to the three preceding ones, but the process of construction was much more simple. An important step was taken by the right direction by making the side plates of the skin of 1/16 in. thickness with the grain longitudinal, while the rest was 1/32 in. thicker with the grain transverse. The total thickness of the skin, after being pressed and sealed, was 3/32 in. and the weight was 46 lb. per sq. ft. The backbone was built up of alternate plates of 1/4 in. birch and poplar. All joints were glued and secured by brass screws. The total weight of this body was 182 lb., made up as follows:

Longeron	27 1/2
Spacer beams and their backbone	17 1/2
Walls, including the backbone	10 1/2
Backbone	40 1/2
Engine	10 1/2
Painting	10 1/2
Wires	10 1/2
Sheet	100 1/2

This body was supported, for the test, on a padded frame,

instead of being suspended from the lift wire attachments. It withstood a factor of 3, but at this loading the skin on its bottom showed a tendency to buckle up towards the center. On the addition of the next load the upper right longeron failed in shear forward of a backbone and the lift joint at this point gave way in tension, while the plywood backbone, which was connected to the two sides of this point, pulled apart. Despite several errors made in its manufacture, such as the use of best joints at portions of great stress and the tacking down of the outer ply of the skin, this body stood up well under the test and bore out the importance of having most of the grain on the skin run longitudinally. Another lesson learned was that it is undesirable to provide too much compression area in the lower longrons, and that when a subject is up to prevent sufficient tension bearing material must be supplied locally. The maximum compression stress was found to be 1900 lb. per sq. in., while the maximum tension stress was 1500 lb. per sq. in.

(See the next column)

## Marlin-Rockwell Airplane Engine

The Marlin-Rockwell Corp., of New Haven, Conn., shortly expects to put on the market a stationary airplane engine of the two-cylinder horizontal opposed type which has been developed by J. L. Cato, formerly experimental engineer of

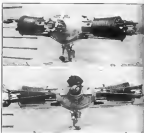


FIG. 4. MARLIN-ROCKWELL ENGINE

the U. S. V. Engineering Corp., and is illustrated herewith in detail and side views.

This engine, which has been designed for use up to and including 200-horsepower size, has been developed by Mr. Cato, but the actual tests given 52 hp. at 1,600 r.p.m., and weight of under 1 lb. per hp. Mr. Cato also intends to develop a more compact 10-hp. model engine which is to develop 500 hp. and weigh about 1 lb. per hp.

## Air Service Equipment Sold

Sales reported to the Office of the Director of Sales include the following Air Service equipment:

- Airplanes . . . . . \$319,000
- Engines . . . . . \$76,000

These machines are U. S. V. equipment sold to the Coast Guard Government.

## The Curtiss-Oriole Transport Airplane



Immediately after the signing of the armistice the Curtiss Aeroplane and Motor Corp. directed the energies of its designers toward the development of aircraft designed to meet the demand of aerial transport. As a result, G. E. Gilchrist, airplane engineer for the Curtiss Engineering Corp. at Garden City, N. Y., designed the Oriole, a three-engine airplane developed primarily with a view to afford comfort to aerial travelers.

The Oriole has a span of 38 ft., an overall length of 28 ft., and an overall height of 9 ft. 5 in. The fuselage is built up of special plywood, in two parts and connected on the center line with five and all stringers acting as stiffening members, then on to backbone, the construction being of the monocoque type. The body is clipped in cross-section, and is painted orange, while the wings are yellow and black; the machine

thus follows the color scheme of the service, after which it is named.

The power plant consists of a Curtiss OX-5 8-cyl., 90 hp. water-cooled engine, driving a tractor propeller. It is equipped with a self starter.

Two cockpits are provided, one forward seating two passengers in hydraulic seats, and one aft making the pilot. The position of the cockpits and a wide window in both places gives passengers and pilot a clear visual range in flight, while windshields protect them from the air blown back by the propeller.

The machine weighs fully loaded 2,185 lb., and carries a useful load of 100 lb. The high speed is 65 m.p.h., and the landing speed 48 m.p.h.

## The Farman Goliath Transport Airplane



The Farman Goliath transport airplane, a converted bomber originally designed by the French Air Service, recently made a series of useful flights.

On Feb. 4 the Goliath carried loads in two pilots, twelve passengers from Paris to London and return, covering the distance of 210 miles in 2 hr. 45 min. on the outward trip, and in 2 hr. 10 min. on the return voyage.

On Feb. 11 the Goliath flew with fourteen passengers from Paris to Brussels and return. The distance of 182 miles was covered in 2 hr. 15 min., and 2 hr. 50 min., respectively. Following this flight the Belgian government authorized, on Feb. 20, the establishment of a regular aerial passenger service between Brussels and Paris, which will operate with a fleet of

ten Goliaths. The gross of the journey, which includes a life insurance for \$30,000, is to be \$60, that is 75 cents per mile. It is intended to eventually link up that service with lines to be run between Amsterdam, Antwerp, Lille, Paris, Bordeaux and Lyon.

On April 2 the Goliath reached an altitude of 26,000 ft. with a pilot, four passengers and ballast representing eight others. The Farman Goliath is a two-engine biplane of 62 ft. span, which is fitted with two 230 h.p. Hispano engines, and has a high speed at ground level of about 110 m.p.h. Accommodations are provided for the passengers in the form of wooden chairs, placed in two rows in the body. The body is braced by cables under the exhaust pipes.



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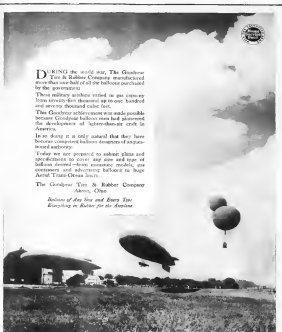
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